单震相微地震事件识别与反演

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Micro-seismic events recognition and inversion in the case of single seismic phase

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摘要 为了对单震相微地震事件进行识别,同时将识别出来的微地震事件进行定位.根据单一震相任意两道到时差与微地震事件、检波器空间位置及震相速度关系的特征规律,研究了单震相微地震事件识别方法.首先分析到时差与以上各变量的内在变化规律,建立起到时差与各变量之间的定量计算关系,然后就相邻道到时差和检波器排列的首尾两道到时差,研究了具体的定量计算关系表达式.利用以上关系式能够计算出上述两种到时差的分布区间.把计算的实际微地震事件的两种到时差与设定的事件的到时差的分布区间对比,以落入区间判断识别单一震相.综合搜索法和遗传算法的特点,提出基于正演模型迭代的解域约束下微地震事件联合反演方法.从迭代误差解的期望概率密度分布、不同解方向的变化特征分析,研究了解域约束的界定条件.在确定的解域范围内,利用遗传算法进行微地震事件的反演.将研究的单震相识别方法,通过对实际资料的应用验证分析,极大地减小了震相的误识率.根据识别资料,利用研究的反演方法对实际资料进行反演.经实际情况对比分析,反演结果和实际的裂缝分布带是一致的,并且反演结果聚敛性效果较好.

关键词： 微地震　单震相识别　震相时差　解域约束　联合反演

Abstract： In order to identify and locate the micro-seismic events of single seismic phase, we have developed a method on the basis of the arrival time difference between any two traces in the case of single seismic phase and the characteristic relationship of micro-seismic events, spatial location of detector and the seismic phase velocity. First, by analyzing the variation of arrival time difference with the change of above variables, we establish the quantitative calculation relationship between the arrival time difference and every variable. Then, with regard to the arrival time differences of the adjacent trace and the first and the last trace of detector array, we research the specific expression of the quantitative calculation relationship. Given the spatial location of the event, we can calculate the distribution range of the above two kinds of arrival time difference using the relation expression above. Comparing the distribution range of two arrival time differences of the actual micro-seismic events with that calculated for the given event, we can identify the single seismic phase with the range which they fall to. Integrating the advantages of the search method and the genetic algorithm, we put forward a micro-seismic joint inversion method based on the solution domain constrained iterative forward model. From the analysis of the expectation probability distribution of the iterative error solution and the variations of different direction of the solutions, we establish the definition conditions of the domain of solution constraints. In the determinate scope of the solution domain, we carry on the inversion of micro-seismic events using the genetic algorithm. Through the analysis of application of practical data, the method of identifying the micro-seismic events reduces the error rate greatly. According to the identified information, we do the inversion of actual data using the inversion method. After comparing with the actual situation, the result is consistent with the actual crack distribution, and is more convergent.

Keywords： Micro-seismic　Single seismic phase recognition　Seismic phase time difference　Constrained solution domain　Integrating inversion

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